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(54) **METHOD AND APPARATUS FOR EXTENDING AN AUTHENTICATION TIMEOUT PERIOD**

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(51) **Int. Cl.**

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G06F 3/01	(2006.01)
G06F 21/88	(2013.01)
H04W 52/02	(2009.01)
G06F 21/81	(2013.01)

(52) **U.S. Cl.**

CPC ***G06F 21/00*** (2013.01); ***G06F 1/3293*** (2013.01); ***G06F 3/01*** (2013.01); ***G06F 21/81*** (2013.01); ***G06F 21/88*** (2013.01); ***H04W 52/02*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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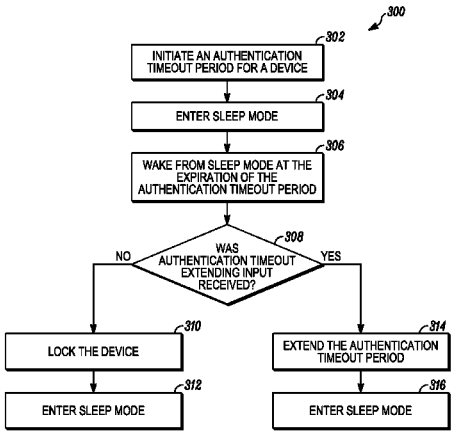
(57) **ABSTRACT**

A method and apparatus for extending an authentication timeout period for an electronic device includes a primary processor of the electronic device initiating an authentication timeout period at a timeout initiation time and putting the primary processor into a sleep mode. The method also includes awakening the primary processor from the sleep mode at an expiration time, upon expiration of the authentication timeout period, and determining whether an authentication timeout extending input was detected by an adjunct processor of the electronic device at an input detection time that occurred during the authentication timeout period. The method further includes extending the authentication timeout period to expire at an extended expiration time, which is based on the input detection time, when the authentication timeout extending input was detected by the adjunct processor or locking the electronic device when the authentication timeout extending input was not detected by the adjunct processor.

20 Claims, 5 Drawing Sheets



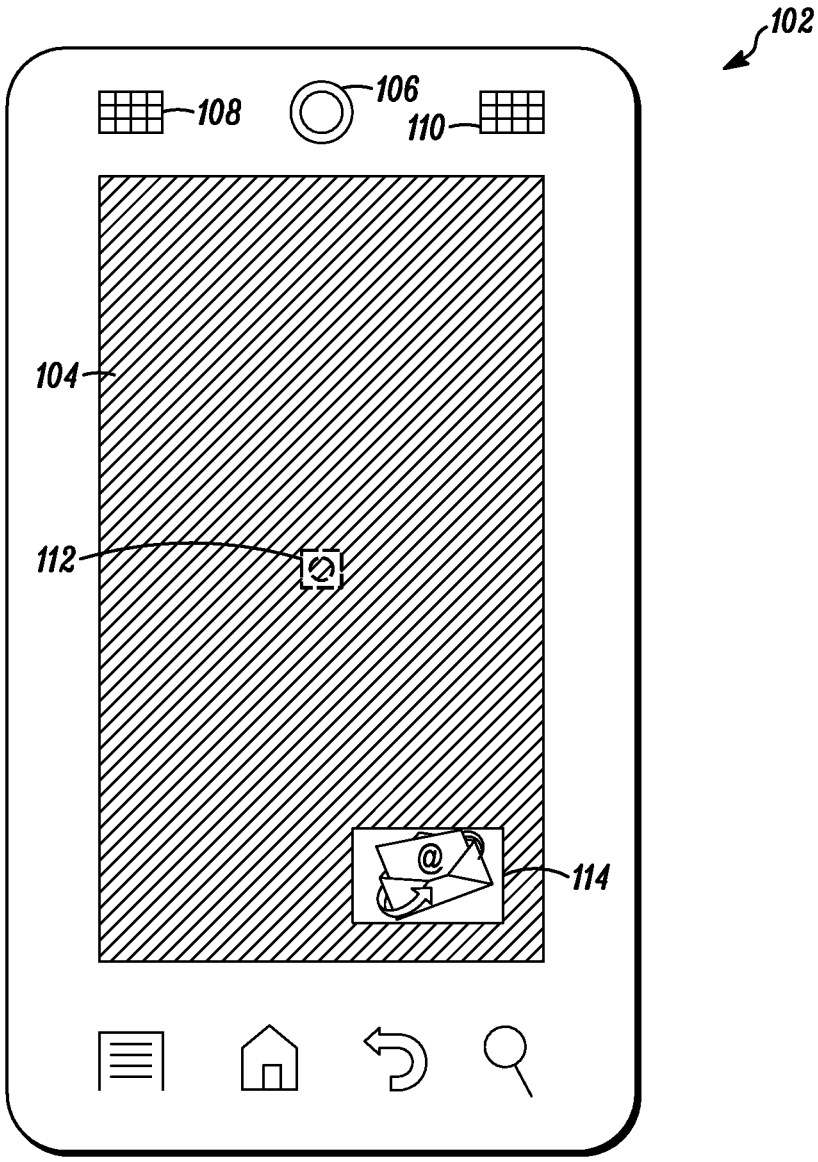


FIG. 1

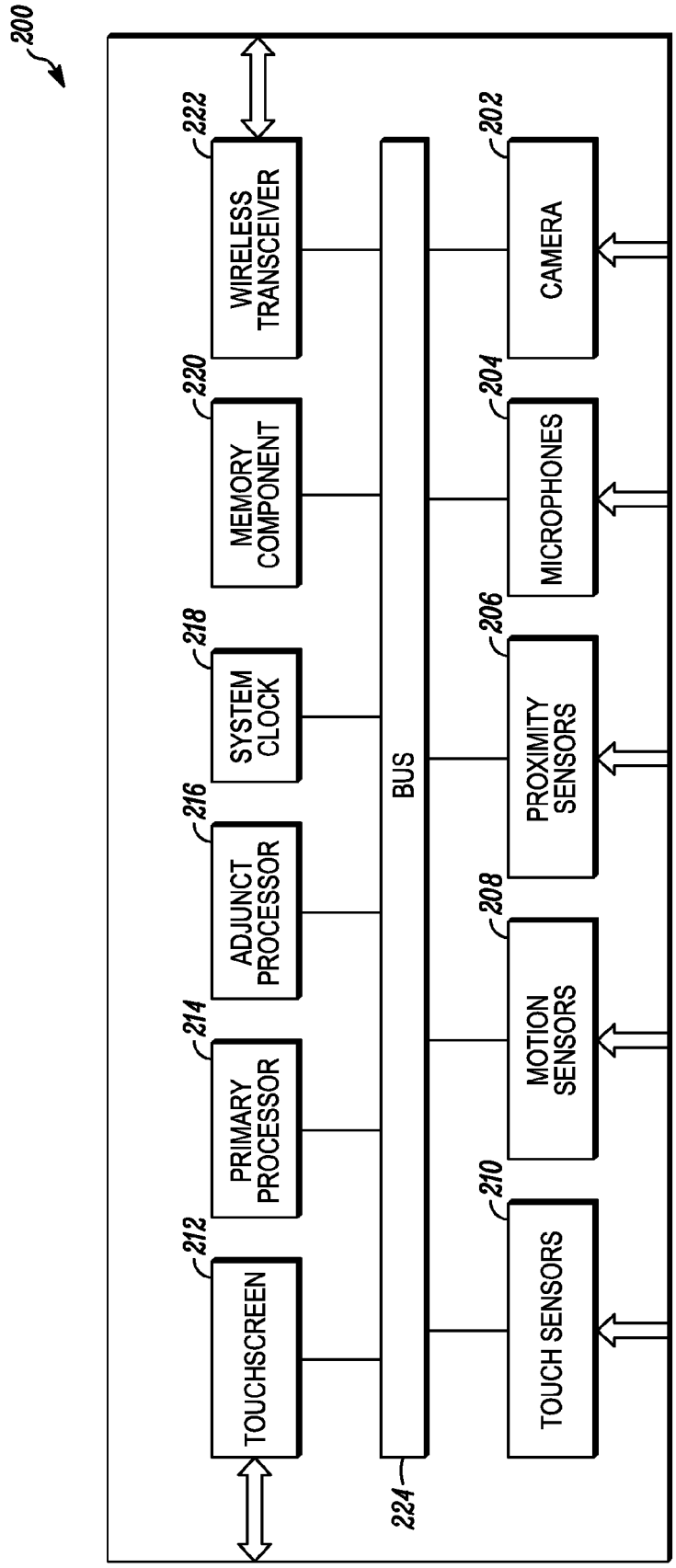

200
222
WIRELESS TRANSCEIVER
220
MEMORY COMPONENT
218
SYSTEM CLOCK
216
ADJUNCT PROCESSOR
214
PRIMARY PROCESSOR
212
TOUCHSCREEN
BUS
224
202
CAMERA
204
MICROPHONES
206
PROXIMITY SENSORS
208
MOTION SENSORS
210
TOUCH SENSORS

FIG. 2

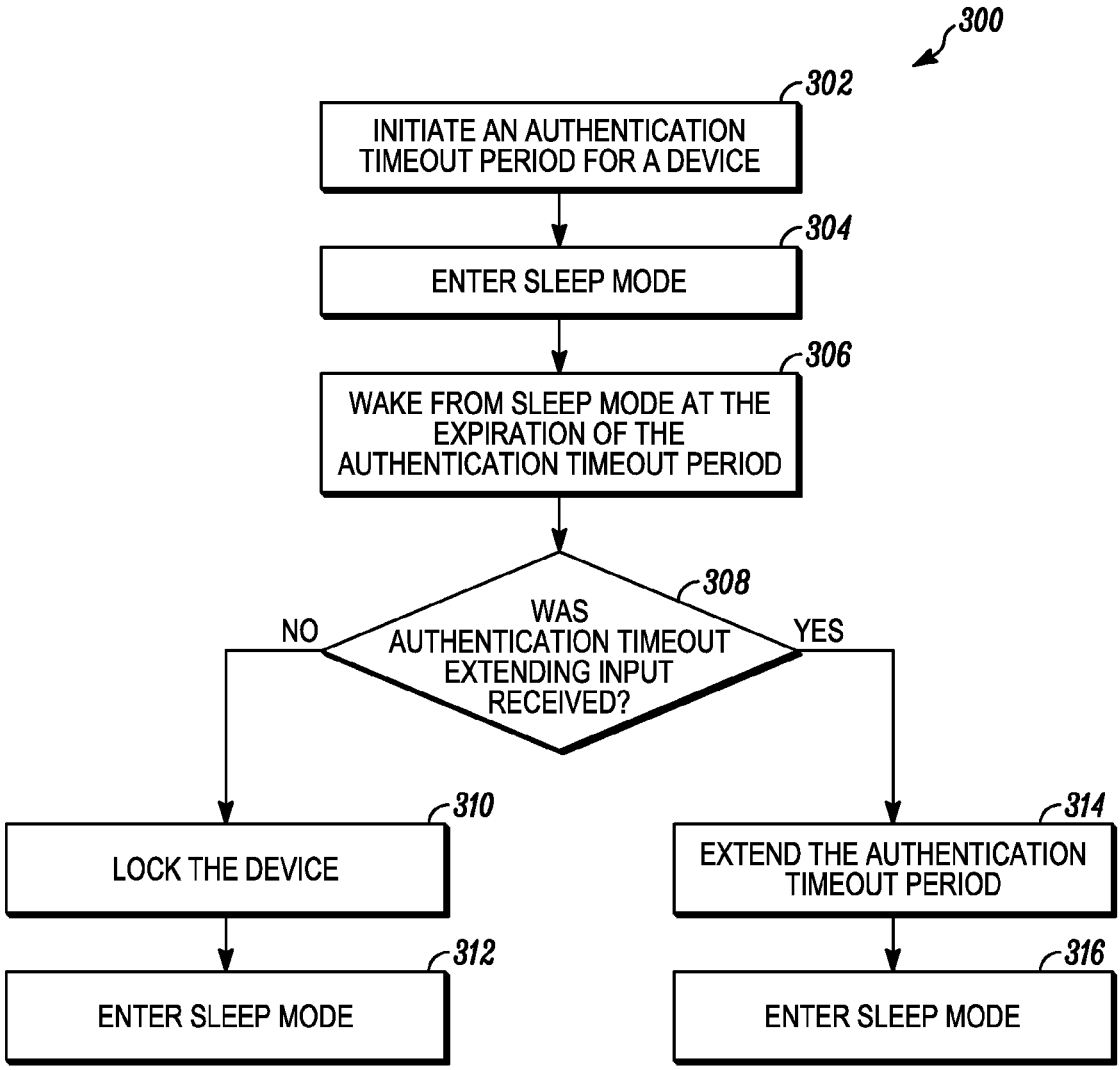

300
302
INITIATE AN AUTHENTICATION TIMEOUT PERIOD FOR A DEVICE
304
ENTER SLEEP MODE
306
WAKE FROM SLEEP MODE AT THE EXPIRATION OF THE AUTHENTICATION TIMEOUT PERIOD
308
WAS AUTHENTICATION TIMEOUT EXTENDING INPUT RECEIVED?
NO
YES
310
LOCK THE DEVICE
312
ENTER SLEEP MODE
314
EXTEND THE AUTHENTICATION TIMEOUT PERIOD
316
ENTER SLEEP MODE

FIG. 3

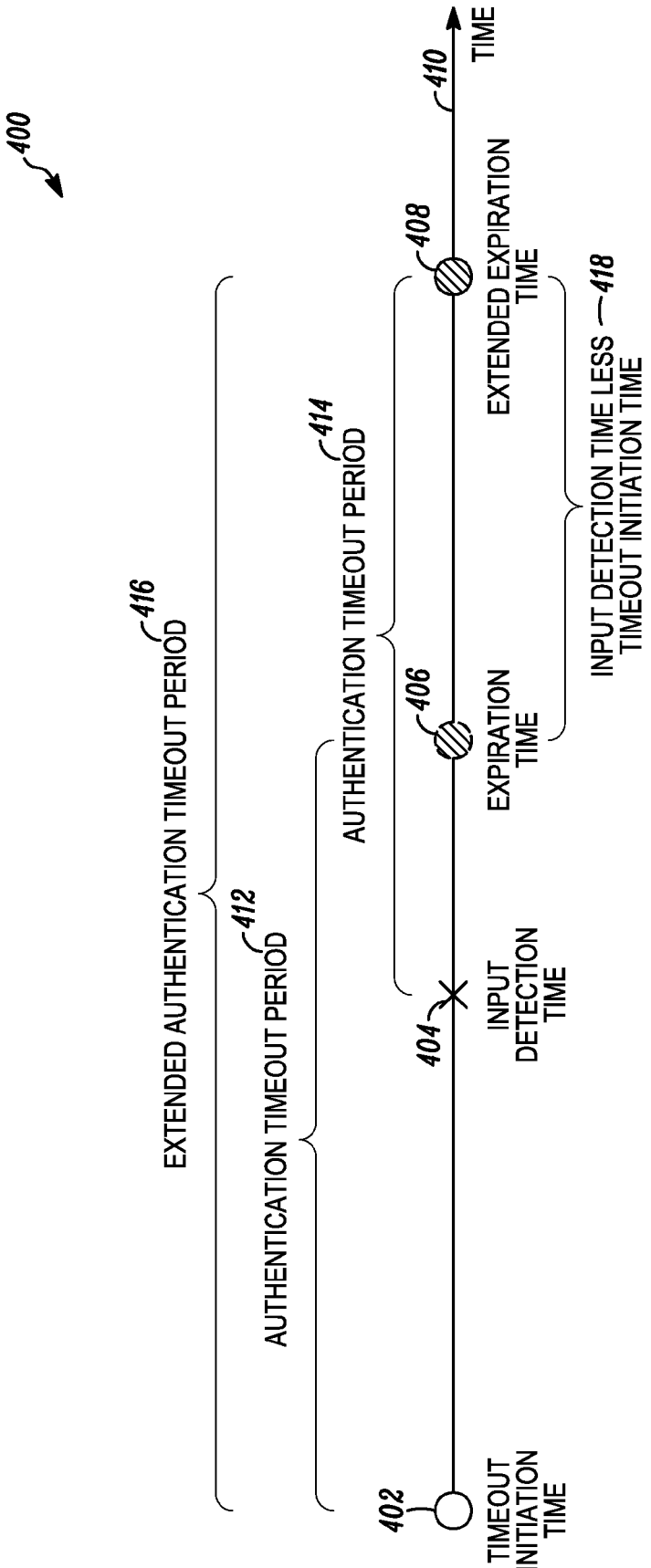

400
TIME
410
408
EXTENDED EXPIRATION TIME
414
AUTHENTICATION TIMEOUT PERIOD
416
EXTENDED AUTHENTICATION TIMEOUT PERIOD
406
EXPIRATION TIME
418
INPUT DETECTION TIME LESS TIMEOUT INITIATION TIME
412
AUTHENTICATION TIMEOUT PERIOD
404
INPUT DETECTION TIME
402
TIMEOUT INITIATION TIME

FIG. 4

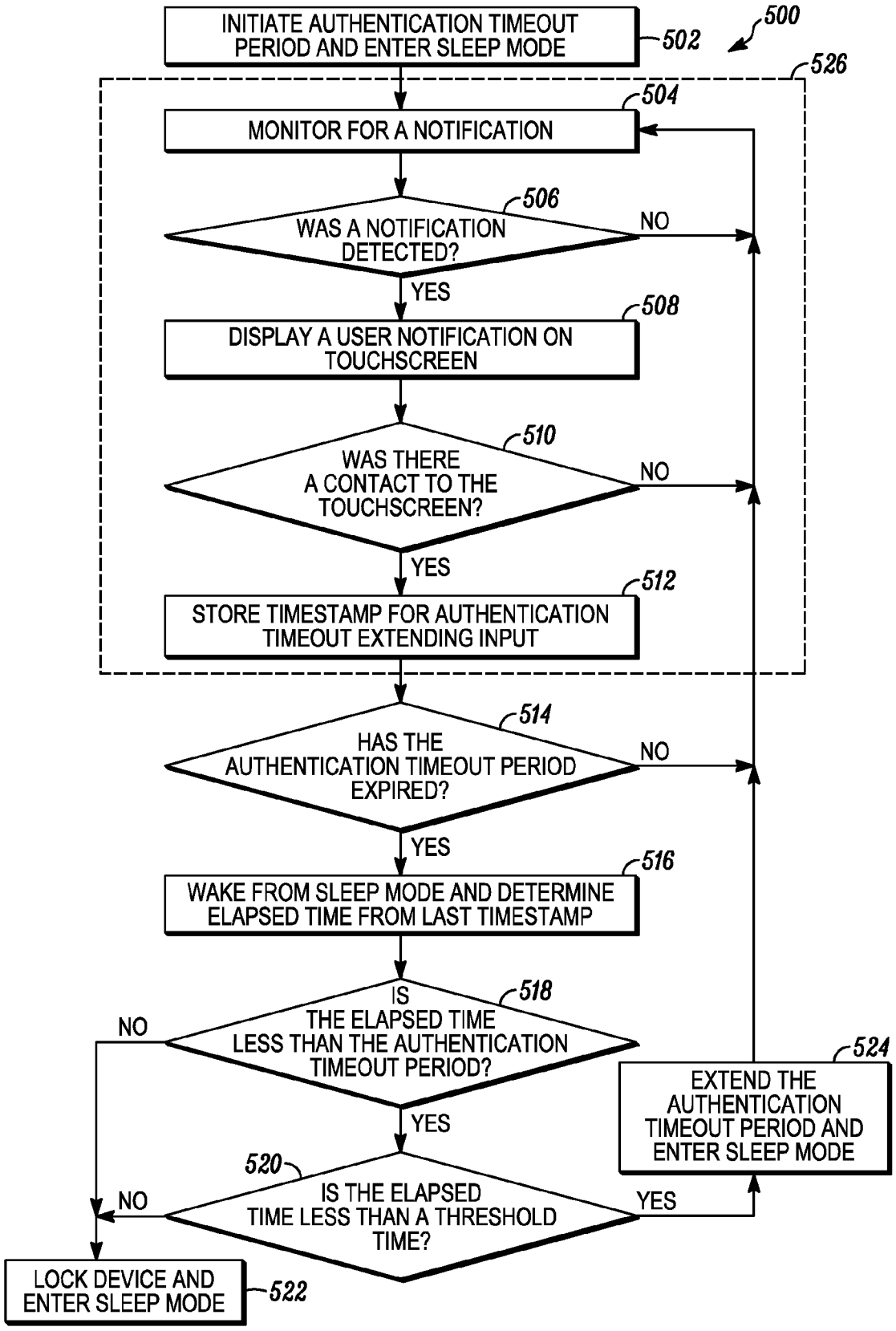

500
INITIATE AUTHENTICATION TIMEOUT PERIOD AND ENTER SLEEP MODE
502
526
504
MONITOR FOR A NOTIFICATION
506
WAS A NOTIFICATION DETECTED?
NO
YES
508
DISPLAY A USER NOTIFICATION ON TOUCHSCREEN
510
WAS THERE A CONTACT TO THE TOUCHSCREEN?
NO
YES
512
STORE TIMESTAMP FOR AUTHENTICATION TIMEOUT EXTENDING INPUT
514
HAS THE AUTHENTICATION TIMEOUT PERIOD EXPIRED?
NO
YES
516
WAKE FROM SLEEP MODE AND DETERMINE ELAPSED TIME FROM LAST TIMESTAMP
518
IS THE ELAPSED TIME LESS THAN THE AUTHENTICATION TIMEOUT PERIOD?
NO
YES
524
EXTEND THE AUTHENTICATION TIMEOUT PERIOD AND ENTER SLEEP MODE
520
IS THE ELAPSED TIME LESS THAN A THRESHOLD TIME?
NO
YES
LOCK DEVICE AND ENTER SLEEP MODE
522

FIG. 5

METHOD AND APPARATUS FOR EXTENDING AN AUTHENTICATION TIMEOUT PERIOD

FIELD OF THE DISCLOSURE

The present disclosure relates generally to locking an electronic device and more particularly to managing an authentication timeout period for locking an electronic device.

BACKGROUND

A sleep mode for an electronic device allows the device to conserve power, and therefore battery life, without powering off. Contrasted against a normal operating mode for the device, the sleep mode consumes less power but also limits both the operations the device can perform and the user interactions the device will recognize. The sleep mode and the normal operating mode represent opposite sides of a balance between efficiency and functionality.

A balancing of benefits also exists between a locked and an unlocked state for a device. The locked state, which represents greater security, is typically imposed after a period of inactivity (an authorization timeout period) and requires a user to authenticate himself by providing a password or biometric data, for example, before access to the device can be regained. Devices used for more sensitive applications are usually associated with more stringent security measures. Users, however, often find authentication annoying and would rather limit the number of times they must provide passwords, pins, swipe patterns, finger prints, facial scans, or other forms of validation.

While the balance between efficiency and functionality can be conditioned on available power and the balance between security and convenience can be conditioned on a frequency of user interactions, conditions for locking a device while the device is in a sleep mode are lacking.

BRIEF DESCRIPTION OF THE FIGURES

The accompanying figures, where like reference numerals refer to identical or functionally similar elements throughout the separate views, together with the detailed description below, are incorporated in and form part of the specification, and serve to further illustrate embodiments of concepts that include the claimed invention, and explain various principles and advantages of those embodiments.

FIG. **1** is a schematic diagram of an electronic device in accordance with some embodiments of the present teachings.

FIG. **2** is a block diagram of an electronic device configured for implementing embodiments in accordance with the present teachings.

FIG. **3** is a logical flowchart of a method for managing an authentication timeout period in accordance with some embodiments of the present teachings.

FIG. **4** is a schematic diagram of an extended authentication timeout period in accordance with some embodiments of the present teachings.

FIG. **5** is a logical flowchart of a method for managing an authentication timeout period in accordance with some embodiments of the present teachings.

Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of embodiments of the present invention. In addition, the description and drawings do not necessarily require the order illustrated. It will be further appreciated that certain actions and/or steps may be described or depicted in a particular order of occurrence while those skilled in the art will understand that such specificity with respect to sequence is not actually required.

The apparatus and method components have been represented where appropriate by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the present invention so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

DETAILED DESCRIPTION

Generally speaking, pursuant to the various embodiments, the present disclosure provides a method and apparatus for extending an authentication timeout period associated with locking an electronic device. More specifically, the method and apparatus allow the authentication timeout period to be extended based on interactions that take place with the device while the device is in a sleep mode. In accordance with the teachings herein, a method performed by a primary processor of an electronic device for extending an authentication timeout period for the electronic device includes initiating an authentication timeout period at a timeout initiation time and putting the primary processor into a sleep mode. The method also includes awakening the primary processor from the sleep mode at an expiration time, upon expiration of the authentication timeout period, and determining whether an authentication timeout extending input was detected by an adjunct processor of the electronic device at an input detection time that occurred during the authentication timeout period. The method further includes extending the authentication timeout period to expire at an extended expiration time, which is based on the input detection time, when the authentication timeout extending input was detected by the adjunct processor or locking the electronic device when the authentication timeout extending input was not detected by the adjunct processor.

Also in accordance with the teachings herein is an electronic device configured to extend an authentication timeout period for the electronic device. The electronic device includes an adjunct processor configured to detect, while a primary processor is in a sleep mode, an authentication timeout extending input occurring at an input detection time during an authentication timeout period initiated at a timeout initiation time. The electronic device further includes the primary processor which is coupled to the adjunct processor. The primary processor is configured to awaken from the sleep mode upon expiration of the authentication timeout period at an expiration time and determine that the authentication timeout extending input was detected by the adjunct processor during the authentication timeout period. The primary processor is also configured to extend the authentication timeout period to expire at an extended expiration time, which is based on the input detection time.

Referring now to the drawings, and in particular FIG. **1**, an electronic device (also referred to herein simply as a "device") implementing embodiments in accordance with the present teachings is shown and indicated generally at **102**. Specifically, device **102** represents a smartphone that is shown to include: a touchscreen **104**, a camera **106**, microphones **108**, **110** (e.g., left **108** and right **110** stereo micro-

phones), and a touch sensor **112** on the backside of the device **102**. Also shown, is a user notification icon **114** on the touchscreen **104**.

While a smartphone is shown at **102**, no such restriction is intended or implied as to the type of device to which these teachings may be applied. Other suitable devices include, but are not limited to: personal digital assistants (PDAs); portable media players (e.g., MP3 players); personal computing devices, such as tablets; and wearable electronic devices, such as devices worn with a wristband. For purposes of these teachings, a device can be any electronic apparatus that is capable of a sleep mode and user authentication.

A sleep mode, as defined herein, indicates an operational state assumed by a device to conserve power over a normal operating state for the device. As the device enters a sleep mode, the device powers down but does not power off. In a sleep mode, for example, the device suspends some operations and/or cuts power to some of its hardware components as random access memory (RAM) for the device receives just enough power to maintain the data needed to resume normal operations. If the power and/or operation of a hardware element, such as a processing element, within the device **102** is reduced or suspended during a sleep mode for the device **102**, then that hardware element is also referred to herein as being in a sleep mode.

User authentication is a process performed by a device, while it is in a locked state, to verify the identity or privileges of a potential user of the device before allowing the user to gain access to the device. User authentication is the implementation of a control policy that excludes access by unauthorized individuals. A locked state for a device, as used herein, is a state for which the device performs user authentication before allowing the authenticated user full or partial access to the device.

Referring to FIG. **2**, a block diagram for a device in accordance with embodiments of the present teachings is shown and indicated generally at **200**. For one embodiment, the block diagram **200** represents the device **102**. Specifically, the block diagram **200** shows: a camera **202**, microphones **204**, proximity sensors **206**, motion sensors **208**, touch sensors **210**, a touchscreen **212**, a primary processor **214**, an adjunct processor **216**, a system clock **218**, a memory component **220**, and a wireless transceiver **222**, all operationally interconnected or coupled by a bus **224**.

A limited number of device elements **202-224** are shown at **200** for ease of illustration, but other embodiments may include a lesser or greater number of such elements in a device, such as device **102**. Moreover, other elements needed for a commercial embodiment of a device that incorporates the elements shown at **200** are omitted from FIG. **2** for clarity in describing the enclosed embodiments. Further, the bus **224** is an abstraction of one or more communication systems that transfer data and/or control signals between the device elements **202-222**. For embodiments where the element **224** represents multiple busses (i.e., multiple communication systems), some of the device elements **202-222** might be coupled to a single bus while others might be coupled to multiple busses, in different combinations, to perform their functionality as described herein.

We now turn to a brief description of the elements within the block diagram **200**. In general, the primary processor **214** and the adjunct processor **216** are configured with functionality in accordance with embodiments of the present disclosure as described in detail below with respect to the remaining figures. "Adapted," "operative," "capable" or "configured," as used herein, means that the indicated elements are implemented using one or more hardware devices such as one or more operatively coupled processing cores, memory devices, and interfaces, which may or may not be programmed with software and/or firmware as the means for the indicated elements to implement their desired functionality. Such functionality is supported by the other hardware shown in FIG. **2**, including the device elements **202-212** and **218-224**.

Continuing with the brief description of the device elements shown at **200**, as included within the device **102**, the processors **214** and **216** include arithmetic logic and registers necessary to perform the digital processing required by the device **102** to process data and operate in a manner consistent with the embodiments described herein. In particular, the primary processor **214** provides main or core processing capabilities within the electronic device **102** and, in an embodiment, serves as an application processor. For example, the primary processor **214** is implemented as a system-on-chip (SoC) that supports word processing applications, email and text messaging applications, video and other image-related and/or multimedia applications, etc., executable on the electronic device **102**. For an embodiment, the primary processor **214** also locks the device **102** upon the expiration of an authentication timeout period (ATP) and unlocks the device upon successfully completing a user authentication procedure.

The ATP, as defined herein, is a time period, initiated by the primary processor **214**, that precedes the primary processor **214** locking the device **102**. In an embodiment, the primary processor **214** locks the device **102** at the expiration of the ATP if no detectable user interaction occurs with the device **102** during the ATP. In a further embodiment, the primary processor postpones locking the device **102** by extending the ATP if one or more of a specific set of events or interactions with the device **102** does occur during the ATP.

The adjunct processor **216** is a separate processor that, in an embodiment, handles peripheral or supportive processes for the primary processor **214**. For example, the adjunct processor **216** monitors tactile input onto the touchscreen **104** in order to perform its functionality according to the present teachings. In a particular embodiment, the adjunct processor **216** supports processes that require less processing power than those performed by the primary processor **214**, allowing for continued operation of the device **102** while the primary processor is in a sleep mode.

In an embodiment, the primary processor **214** and the adjunct processor **216** are operationally coupled by the bus **224** that includes a communications link supporting one or more standard or proprietary protocols for communicating data, control signals, and/or clock signals between the processors **214** and **216**. For a particular embodiment, the communications link is supported by a bidirectional Mobile Industry Processor Interface (MIPI). MIPIs support numerous protocols including, but not limited to M-PHY, D-PHY, Display Serial Interface (DSI), MIPI Unified Protocol (UniPro), Low Latency Interface (LLI), SuperSpeed Inter-chip (SSIC), and Camera Serial Interface (CSI), to name a few. MIPI is a chip-to-chip interface that conforms to standards created by the MIPI Alliance Standards Body, which standardizes interfaces for mobile applications.

In addition to being operationally coupled to the primary processor **214**, the adjunct processor **216** is also operationally coupled to the input devices **202-212** and **222**, enabling the adjunct processor **216** to monitor those devices for input. Input device **202** represents an optical input module, in this case a camera, that allows a device, such as device **102**, to capture images in the vicinity of the device **102** and to convert those images to image data that can be processed by the adjunct processor **216**. Generally, a device, such as device

102, is designed to capture useful image data in a vicinity of the device, or within a distance for which a user can interact with the device **102**. Image data represents the informational content of an image, or a set of images, independent of its encoded format. In a first example, the camera **202** captures an image of a user's face. In a second example, the adjunct processor **216** processes sequentially captured images to determine that an object is moving in the vicinity of the device **102**.

One or more acoustic transducers **204**, such as the microphones **108** and **110**, enable the device **102** to receive acoustic input. For an embodiment, microphones **204** allow a user to interact with the device **102** through speech. The device **102** can accept a set of verbal commands, for example, or be programmed to detect and react to non-verbal sounds. Particular sounds, for instance, can indicate that a user is in proximity to the device **102**. In another embodiment, a user's proximity to the device **102** can be detected by one or more proximity sensors **206**. The proximity sensors **206** for the device **102** can be active and or passive. For an embodiment, an active proximity sensor determines a proximity or distance to an object by measuring the time it takes for a signal, such as a light signal, transmitted by the device **102** to be detected by the device **102**. For another embodiment, a passive proximity sensor detects a signal, such as an infrared or thermal signal, emanating from a user or an electronic signal being transmitted by a separate device carried on the user's person, to determine proximity. In one embodiment, the camera **106** of device **102** is used to perform the function of the proximity sensors **206**.

The block element **208** represents one or more motion sensors that allow the device **102** to determine its motion relative to its environment. The motion sensors **208** can include, but are not limited to: accelerometers, velocity sensors, air flow sensors, gyroscopes, and global positioning system (GPS) receivers. Multiple sensors of a common type can also take measurements along different axial directions. For some embodiments, the motion sensors **208** include hardware and software elements that allow the device **102** to triangulate its position using a communications network. In further embodiments, the motion sensors **208** allow the device **102** to determine its position, velocity, acceleration, additional derivatives of position with respect to time, and average quantities associated with the aforementioned values. For a particular embodiment, the device **102** uses one or more motion sensors **208** to determine that it is being shaken.

From the input of one or more touch sensors **210**, the device **102** can determine if it is in contact with another object. The device **102** can be placed on a table, for instance, or held in a user's hand. For example, the touch sensor **112** of FIG. **1** is shown on the back of the device **102**, where a user is most likely to be holding the device **102**. In a particular embodiment, the touch sensors **210** uses capacitive sensors to detect anything contacting the communication device **102** that is conductive or has a dielectric constant different than that of air. In alternate embodiments, the touch sensors **210** utilize pressure sensitive areas or photo sensors to measure the user's contact points with the device **102**. Where pressure sensitive areas are used, for example, a change in pressure indicates a portion of a user's body is being pressed against the device **102**. For photo sensors, contact by the user with the device **102** blocks the light that the sensors receive.

The adjunct processor **216** can also detect a contact to a touchscreen **212** of the electronic device **102**, such as touchscreen **104**. The touchscreen **104** provides a means for receiving tactile (or touch) input from a user's finger or some other input device, such as a stylus. In particular embodiments, the touchscreen **104** can operate in accordance with any suitable technology for sensing touch such as, by way of example, a resistive touchscreen or a capacitive touchscreen. The touchscreen **212** is operationally coupled to the adjunct processor **216** using the bus **224**, which in an embodiment includes communication interfaces (not shown) for communicating data between the touch screen **212** and the adjunct processor **216**.

The touchscreen **104** can also display data, as indicated by the e-mail notification icon **114**. For an embodiment, the touchscreen **104** is a liquid crystal display (LCD) that translates electrical signals it receives into a given image. Each pixel of the image **114**, for example, can correspond to a capacitor within the touchscreen **104** that is charged and slowly discharged to display the icon **114**.

As shown in FIG. **1**, the touchscreen **104** is in a sleep mode. A primary portion of the touchscreen **104** is not illuminated, as indicated by the shading at **104**. For an embodiment, the limited functionality of the touchscreen **104** while in sleep mode allows it to intermittently display an interactive notification, such as the e-mail notification icon **114**. The device **102** receives an e-mail while in a sleep mode. Without powering up the entire touchscreen **104**, the device **102** displays a small notification icon in the lower-right portion of the touchscreen **104**, as shown at **114**, that fades in and out of view for a period of time. This intermittent displaying of an interactive notification icon while the device **102** is in a sleep mode is referred to herein as "breathing." The period of time the icon **114** breaths is sufficient to allow a user to tap (or otherwise make contact with) the touchscreen **104**, for instance, at the location of or in a vicinity of the icon **114**, to view or "peek" at additional information about the e-mail. When the breathing icon **114** is tapped, the device **102** momentarily displays pre-selected content from the email, including but not limited to the e-mail's subject line and sender, at the location of the icon **114**. If the user chooses to do so, he can wake the device **102** from its sleep mode and read the e-mail.

The duration of time the notification icon **114** is displayed on the touchscreen **104** can be measured by the system clock **218**, which, for an embodiment, is operationally coupled to both the primary **214** and the adjunct **216** processors. For an embodiment, the system clock **218** provides timecodes that allow the processors **214**, **216** to track time. In a further embodiment, the system clock **218** is configured to determine the expiration time and determine the input detection time. The primary processor **214**, for example, can query the system clock **218** for timecodes that indicate the time and determine the length of a time interval by determining a time difference between timecodes. Additionally or alternatively, the primary **214** and/or the adjunct **216** processors may have integrated clocks that allow the processors **214**, **216** to track time in accordance with the teachings herein. For example, the primary processor **214** includes a first clock configured to determine the expiration time, and the adjunct processor **216** includes a second clock configured to determine the input detection time.

The memory component **220** represents a storage location that is accessible to the adjunct processor. In one embodiment, the memory component **220** represents cache memory integrated with the adjunct processor **216**. In another embodiment, the memory component **220** represents a portion of RAM for the device **102**. In a further embodiment, the memory component **220** is also accessible to the primary processor **214**.

The wireless transceiver **222** allows the device **102** to upload and download data to and from one or more networks, such as a wireless local area network (WLAN) or a cellular

network. A WLAN transceiver **222** allows the device **102** direct access to the Internet using standards such as Wi-Fi, which is offered at hotspots. For embodiments where the wireless transceiver **222** is a cellular transceiver, cellular networks can use any wireless technology that, for example, enables broadband and Internet Protocol (IP) communications including, but not limited to, 3rd Generation (3G) wireless technologies such as CDMA2000 and Universal Mobile Telecommunications System (UMTS) networks or 4th Generation (4G) or pre-4G wireless networks such as LTE and WiMAX.

A power supply (not shown) supplies electric power to the device elements **202-224**, as needed, during the course of their normal operation. The power is supplied to meet the individual voltage and load requirements of the device elements **202-224** that draw electric current. The power supply also powers up and powers down the device **102**. For a particular embodiment, the power supply includes a rechargeable battery.

We turn now to a detailed description of the functionality of the device **102** and the device elements shown in FIGS. **1** and **2** at **102** and **200**, respectively, in accordance with the teachings herein and by reference to the remaining figures. FIG. **3** is a logical flow diagram illustrating a method **300** performed by a primary processor of a device, taken to be the primary processor **214** of device **102** for purposes of this description, for managing an ATP in accordance with some embodiments of the present teachings. Specifically, the primary processor **214** initiates **302** an ATP for the device **102** at a timeout initiation time. For an embodiment, the ATP is a period of time, the length of which is set by a user for instance, that the device **102** (more particularly the primary processor **214**) uses to determine whether or not to lock the device **102** contingent on activity or inactivity as relates to the device **102**. For other embodiments, the length of the ATP is determined by an algorithm or preprogrammed by an administrator or a manufacturer of the device **102**. In an embodiment represented by the method **300**, the primary processor **214** enters **304** a sleep mode between the initiation **302** of the ATP for the device **102** and the primary processor **214** waking **306** from the sleep mode at an expiration time (end) of the ATP.

While the primary processor **214** is asleep, the adjunct processor **216** monitors the device **102**, specifically its various sensors and components (e.g., **202-212**) for an authentication timeout extending input. The accompanying philosophy of use is that if a user intentionally interacts with the device **102** while the primary processor **214** is asleep, then that interaction should be considered in determining whether to extend the ATP before locking the device **102**. An authentication timeout extending input is a subset (not necessarily a proper or strict subset) of the input the device is capable of receiving that has the ability to extend the ATP. What type of input qualifies as timeout extending input can be determined by an algorithm or preprogrammed by an administrator or a manufacturer of the device **102**.

For a first embodiment, the authentication timeout extending input is generated as a result of a contact to the touchscreen **104** of the electronic device **102** after a notification is displayed on the touchscreen **104**. To implement this embodiment, the device **102** includes the touchscreen **104** coupled to the adjunct processor **216**, wherein the touchscreen **104** is configured to detect tactile input and responsively provide the authentication timeout extending input to the adjunct processor **216**. Contact to the touchscreen **104** may be made with a user's finger or other implement, such as a stylus. When the user sees the breathing e-mail notification icon **114**, for example, the user taps on the touchscreen **104** to display more information about the e-mail. In doing so, the touchscreen **104** responsively provides the authentication timeout extending input that the adjunct processor **216** detects.

For a second embodiment, the authentication timeout extending input is generated as a result of a contact to a housing of the electronic device **102**. To implement this embodiment, the device **102** includes the at least one touch sensor **210** coupled to the adjunct processor **216**, wherein the at least one touch sensor **210** is configured to detect tactile input and responsively provide the authentication timeout extending input to the adjunct processor **216**. The touch sensor **112** located on the backside of the device housing, for example, detects a user's hand cradling the device while the user views or interacts with the touchscreen **104** and provides the authentication timeout extending input to the adjunct processor **216**. In additional embodiments, touch sensors **210** are placed at different locations on the device **104**, such as along the edges of the device **102** to detect an alternate grip that "pinches" the device **102** between the user's thumb and fingers and, responsively, provide the authentication timeout extending input to the adjunct processor **216**.

For a third embodiment, the authentication timeout extending input is generated as a result of shaking the electronic device **102**. To implement this embodiment, the device **102** includes the at least one motion sensor **208** coupled to the adjunct processor **216**, wherein the at least one motion sensor **208** is configured to detect a motion of the device **102** and responsively provide the authentication timeout extending input to the adjunct processor **216**. To display the time or solicit more information about a breathing notification while the device **102** is asleep, for instance, a user shakes the device **102** in a way to cause detection by one or more motion sensors **208**, which responsively provide the authentication timeout extending input to the adjunct processor **216**. To distinguish a user's intentional shaking from environmental vibration, the user might "twist" or "roll" the device **102** back and forth about a pivot point by supinating his forearm. Alternatively, the user can "wave" the device back and forth, or trace a geometric pattern, through a distance larger than that associated with environmental vibration.

For a fourth embodiment, the authentication timeout extending input is generated as a result of an object being in proximity to the electronic device **102**. To implement this embodiment, the device **102** includes the at least one proximity sensor **206** coupled to the adjunct processor **216**, wherein the at least one proximity sensor **206** is configured to detect proximity of an object to the device **102** and responsively provide the authentication timeout extending input to the adjunct processor **216**. The proximity sensors **206**, for example, might detect that a user, who stopped interacting with the device **102**, remains in proximity to the device **102** and, responsively, provide the authentication timeout extending input to the adjunct processor **216**. Alternatively, the motion sensors **206** might detect an approach by the user, such as when the user walks into his office, where the device **102** is located and, responsively, provide the authentication timeout extending input to the adjunct processor **216**. In a specific case, proximity of the user might not constitute an authentication timeout extending input until or unless the user is within a threshold distance of the device **102**. In a further example, a separate device located on the user's person identifies the user to the device **102**.

For a fifth embodiment, the authentication timeout extending input is generated as a result of a gesture directed to the electronic device **102**. A user can communicate his intent to interact with the device **102** by gesturing to the device **102**. Rather than shaking or tapping the device, for example, the

user waves his hand in front of the camera **106**. The device then compares sequentially captured images to determine the hand's motion. In another case, the device **102** compares a captured image of the user's hand to stored images of specific gestures to determine if the user is gesturing in a recognizable way, showing his intent to interact with the device **102**. The adjunct processor **216** treats recognized gestures as authentication timeout extending input.

For a sixth embodiment, the authentication timeout extending input is generated as a result of speech input into the electronic device **102**. To implement this embodiment, the device **102** includes at least one acoustic transducer (e.g., microphones **108**, **110**) coupled to the adjunct processor **216**, wherein the at least one acoustic transducer **108**, **110** is configured to detect audio input and responsively provide the authentication timeout extending input to the adjunct processor **216**. For example, the adjunct processor **216** might recognize particular verbal commands or the specific speech pattern of a user as authentication timeout extending input. A speech processing module (not shown), for example, can analyze phonemes, the phonetic building blocks of speech, captured by the microphones **108**, **110**. The device **102** compares the captured phonemes against phonemes stored in a database and calculates a confidence score that the captured phonemes represent a command or a user's speech pattern. When the confidence score exceeds a threshold score, the adjunct processor stores a timestamp to a location in the memory component **220** for the captured speech, which is identified as authentication timeout extending input.

In different embodiments, the device **102** uses different means to determine whether a user is interacting with the device **102** and whether the user is interacting with the device **102** in an intentional way or unintentionally. For example, motion that the device **102** experiences while being carried in a handbag or contact with another item in the handbag are not events that constitute intentional user interaction. Further, the user speaking directly to another person, rather than to the device **102**, or the user making momentary contact with the touchscreen **104** of the device **102** are not events that constitute intentional interaction with the device **102**. An event, as used herein, is an occurrence that is detectable by the device **102** that may or may not be authentication timeout extending input.

In one embodiment, the adjunct processor **216** detects an event as an authentication timeout extending input only when the duration of an event exceeds a threshold time interval, which can, for instance, be set by the user or another programmer of the device **102**. For example, a contact to the touchscreen **104** of the device **102**, a contact to the housing of the device **102**, a shaking of the device **102**, or a gesture directed to the device **102** are events that are only determined to be authentication timeout extending input if they are sustained for a time period long enough to indicate that the user has intent to interact with the device **102**.

In another embodiment, the adjunct processor **216** determines that user input that is repeated is authentication timeout extending input. For example, the user taps the touchscreen **104** not once but twice in succession or the user shakes the device back and forth numerous times to communicate intent to interact with the device **102**.

When the adjunct processor **216** detects device input that qualifies as timeout extending input, the adjunct processor **216** uses an integrated clock or the system clock **218** to associate a timestamp with the input. The timestamp, which indicates the input detection time of when the adjunct processor **216** detected the timeout extending input, is stored in the memory component **220** of the device **102**, which in different embodiments can be a cache memory of the adjunct processor **216** and/or a separate memory component that is accessible to both the adjunct processor **216** and the primary processor **214**.

The primary processor wakes **306** at the expiration time of the ATP to determine if the device **102** should be locked, or alternatively, if the ATP should be extended. Which of the two actions the primary processor **214** takes is based upon whether the adjunct processor **216** detected one or more authentication timeout extending inputs while the primary processor **214** was sleeping. The primary processor **214** queries the adjunct processor **216** over a communication link between the two processors **214**, **216** to determine **308** if an authentication timeout extending input was received by the adjunct processor **216** during the ATP. Alternatively, the primary processor **214** checks for one or more timestamps stored in a predetermined location of the memory component **220** for an indication that the adjunct processor **216** received one or more corresponding authentication timeout extending inputs. For this embodiment, the device includes the memory component **220** coupled to the adjunct processor **216** and the primary processor **214**, wherein the memory component **220** is configured to store a timestamp that indicates the input detection time.

If no authentication timeout extending input was received, then the primary processor locks **310** the device **102** and returns **312** to sleep mode until a user wakes the device **102** and performs an authentication procedure. Alternatively, if an authentication timeout extending input was received during the ATP, then the primary processor extends **314** the ATP and returns **316** to sleep mode until the extended ATP expires.

For a particular embodiment, the primary processor **214** extends **314** the ATP to expire at an extended expiration time of the expiration time plus the input detection time less the timeout initiation time. This embodiment is described in greater detail with reference to FIG. **4**. Shown in FIG. **4** at **400** is a schematic diagram that graphically illustrates the extension of the ATP. Specifically, diagram **400** includes a time axis **410**, with increasing time directed to the right, upon which four points in time are indicated at **402**-**408**. Point **402** represents the timeout initiation time, which is the time the primary processor **214** initiates an ATP **412**. The ATP **412** ends at an expiration time indicated at **406**. Indicated at **404** is an input detection time, which is the time at which an authentication timeout extending input was detected by the adjunct processor **216**.

Upon waking at the expiration time **406** and determining that authentication timeout extending input was detected by the adjunct processor **216** at the input detection time **404**, the primary processor **214** extends the ATP **412** as shown at **416** to expire at an extended expiration time **408**. In one particular embodiment, the primary processor **214** extends the ATP **412** such that an extended ATP **416** expires at a time interval after the input detection time **404** that is equal to the ATP **412**, as shown at **414**. Equivalently, the primary processor **214** extends the ATP **412** at the expiration time **406** by an amount of time equal to the input detection time **404** less the timeout initiation time **402**, as indicated at **418**.

In an embodiment in which the adjunct processor **216** detects multiple authentication timeout extending inputs during the ATP **412**, the primary processor **214** uses the timestamp of the last authentication timeout extending input detected as the input detection time **404**. The primary processor **214** then extends the ATP **412** based on that input detection time **404** alone. In an alternate embodiment, the primary processor **214** sets the extended expiration time **408** based on a number of input detection times of multiple authentication

timeout extending inputs detected during the ATP **412**. For example, the primary processor **214** can extend the ATP **412** by 5 minutes for each authentication timeout extending input detected by the adjunct processor **214**. In a further embodiment, the primary processor **214** extends the ATP **412** by a fixed amount of time (e.g., 20 minutes) independent of how many timeout extending inputs were detected, as long as at least one authentication timeout extending input detected by the adjunct processor **214** during the ATP **412**.

In another embodiment, the extended expiration time **408** is further based on a type of authentication timeout extending input received. A user checking the time, for instance, while the primary processor **214** is asleep might result in a shorter ATP extension than if the user had tapped on a notification icon. In the case of multiple authentication timeout extending inputs, the primary processor **214** might set the extended expiration time **408** as a function of the number and types of input, $f(x_1, x_2, x_2)$, where x_1, x_2, and x_3 represent inputs of a first, second, and third type, respectively. For example, the primary processor might extend the ATP **412** by 3 minutes for each first-type input received, by 5 minutes for each second-type input received, and by 10 minutes for each third-type input received.

Under the paradigm for extending the ATP **412** illustrated in diagram **400**, the extended expiration time **408** falls beyond the expiration time **406** by the same amount of time as the input detection time **404** falls beyond the timeout initiation time **402**. If, for example, the only authentication timeout extending input to occur during the ATP **412** happened one minute after the timeout initiation time **402**, then the ATP would only be extended by one minute. Because waking the primary processor **214** again after only a one-minute interval is an inefficient use of resources, and further because little is likely to change in a minute, the primary processor **214** locks the electronic device **102** when no authentication timeout extending input was detected beyond a threshold time interval of the timeout initiation time **402**. For an embodiment, when an authentication timeout extending input is detected, the primary processor **214** extends the ATP **412** to expire at the extended expiration time **408** when the input detection time **404** is outside of (i.e., beyond) a threshold time interval of the timeout initiation time **402**. When the input detection time **404** is within the threshold time interval of the timeout initiation time **403**, the primary processor locks the device **102**. The threshold time interval can be set to 30 seconds, a minute, or any other time interval a user, administrator, or manufacturer chooses.

In a further embodiment, the paradigm for extending the ATP **412** illustrated in diagram **400** can be repeated so that the primary processor **214** applies a second extension to the ATP **412**, or equivalently, applies a first extension to the extended ATP **416**. Specifically, after the primary processor **214** extends **314** the ATP **412** and returns **316** to sleep, the primary processor **214** again wakes from sleep mode, as it did at **306**, but this time at the extended expiration time **408**. The primary processor **214** then determines whether a subsequent authentication timeout extending input was detected by the adjunct processor **216** at a subsequent input detection time (not shown) that occurred after the expiration time **406**.

If a subsequent authentication timeout extending input was not detected by the adjunct processor **214**, the primary processor **214** locks the device **102** and returns to sleep mode. If, however, a subsequent authentication timeout extending input was detected by the adjunct processor **216** between the expiration time **406** and the extend expiration time **408** at a subsequent input detection time (not shown), then the primary processor **214** extends the extended ATP **416** by a time interval equal to the subsequent input detection time less the first input detection time **404**. After extending the extend ATP **416**, the primary device **214** again returns to sleep mode until the expiration of the twice-extended ATP (not shown). Continuing the method of diagram **400**, the primary processor **214** may repeatedly extend the ATP **412** as long as the adjunct processor **216** repeatedly detects additional authentication timeout extending inputs that occur between the previous two expiration times.

For one embodiment, the primary processor **214** postpones locking the device **102** if the device **102** is in the presence of a wireless access point. A wireless access point, as used herein, is a physical device that allows another device, such as device **102**, to establish a wireless connection to a wired or wireless network. The device **102** is in the presence of a wireless access point when it is close enough to the wireless access point to establish a connection to the wired or wireless network (e.g., the device **102** being located within a Wi-Fi hotspot). For a particular embodiment, the device **102** is in the presence of the wireless access point when a signal strength associated with the wireless access point is above a threshold signal strength. If, for example, the adjunct processor **216** does not detect an authentication timeout extending input between the timeout initiation time **402** and the expiration time **406**, or if it does not detect subsequent authentication timeout extending input between the expiration time **406** and the extended expiration time **408**, then the primary processor **214** does not lock the device **102** at the expiration time **406**, or at the extended expiration time **408**, respectively, while the device **102** is in the presence of a wireless access point.

In a first embodiment, the detected presence of a wireless access point is treated as authentication timeout extending input and the primary processor **214** extends the ATP **412** accordingly and returns to sleep mode. In a second embodiment, the primary processor **214** remains awake and locks the device **102** immediately after detecting that the device **102** is no longer in the presence of the wireless access point, unless an authentication timeout extending input was received within the last time period by which the ATP **412** was extended. For a particular embodiment, the device **102** remains unlocked in the presence of a wireless access point only when the wireless access point is a trusted wireless access point. In one embodiment, a trusted wireless access point is a wireless access point a user of device **102** has indicated to the device **102** he trusts. In another embodiment, a trusted wireless access point is a wireless access point on a list of trusted wireless access points compiled by some authority (e.g., Norton, McAfee) that is stored either locally on device **102** or accessible to device **102** via the wireless access point and the wireless transceiver **222**.

FIG. **5** is a logical flowchart of a method **500** for managing an ATP, such as the ATP **412**, that, in contrast to FIG. **3**, shows actions performed by both the primary processor **214** and the adjunct processor **216**. In a particular embodiment, the actions of the adjunct processor **216** are indicated within a dashed box **526**. Whereas, the remaining actions shown in FIG. **5** are performed by the primary processor **214**. Specifically, the method **500** includes the primary processor **214** initiating **502** the ATP **412** and entering **502** a sleep mode. While the primary processor **214** is sleeping, the adjunct processor **216** monitors **504** for notifications. Notifications are messages that the adjunct processor **216** receives from other elements within the device **102** that indicate the status of the device **102** has changed in a way that warrants a user notification. If the adjunct processor **216** detects **506** a notification, it instructs the device **102** to display **508** a user notification on the touchscreen **104**. For a particular embodi-

ment, the adjunct processor **216** receives a notification of an incoming e-mail and instructs the device **102** to display the breathing e-mail notification icon **114** on the touchscreen **104**. If the adjunct processor **216** does not detect **506** a notification, it continues to monitor **504** for one.

After the user notification is displayed, the adjunct processor **216** determines **510** if a user makes contact with the touchscreen **104**. If the user does make contact with the touchscreen **104**, the adjunct processor **216** detects the contact as an authentication timeout extending input and stores **512** a timestamp for the input. If the user does make contact with the touchscreen **104**, the adjunct processor **216** again monitors **504** for other notifications. The adjunct processor **216** continues to monitor **504** for notifications until the ATP **412** expires **514**.

When the ATP **412** expires **514**, the primary processor **214** wakes **516** and determines **516**, for instance by querying the adjunct processor **216** or performing a calculation based on the stored timestamp, the elapsed time from the last authentication timeout extending input as calculated from the timestamp for that input. If the primary processor **214** determines **518** the elapsed time is greater than the ATP **412**, then no authentication timeout extending input was detected by the adjunct Processor **216** during the ATP **412**, and the primary processor **214** locks **522** the device **102** and enters **522** sleep mode.

If the primary processor **214** determines **518** the elapsed time is less than the ATP **412**, the primary processor **214** then determines **520** if the elapsed time is less than a threshold time. The elapsed time being less than a threshold time indicates that the last authentication timeout extending input did not occur just after the timeout initiation time **402**. In that case, the primary processor **214** extends **524** the ATP **412**, as indicated in the diagram **400**, and returns **524** to sleep mode as the adjunct processor **216** continues to monitor **504** for notifications. If the elapsed time is greater than the threshold time, while still being less than the ATP **412**, then the last authentication timeout extending input occurred just after (within a threshold of) the timeout initiation time **402**. In that case, the primary processor **214** locks **522** the device **102** and enters **522** sleep mode rather than extending the ATP **412** by only a very short duration.

In the foregoing specification, specific embodiments have been described. However, one of ordinary skill in the art appreciates that various modifications and changes can be made without departing from the scope of the invention as set forth in the claims below. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present teachings.

The benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential features or elements of any or all the claims. The invention is defined solely by the appended claims including any amendments made during the pendency of this application and all equivalents of those claims as issued.

Moreover in this document, relational terms such as first and second, top and bottom, and the like may be used solely to distinguish one entity or action from another entity or action without necessarily requiring or implying any actual such relationship or order between such entities or actions. The terms "comprises," "comprising," "has," "having," "includes," "including," "contains," "containing" or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises, has, includes, contains a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "comprises . . . a," "has . . . a," "includes . . . a," or "contains . . . a" does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises, has, includes, contains the element. The terms "a" and "an" are defined as one or more unless explicitly stated otherwise herein. The terms "substantially," "essentially," "approximately," "about" or any other version thereof, are defined as being close to as understood by one of ordinary skill in the art, and in one non-limiting embodiment the term is defined to be within 10%, in another embodiment within 5%, in another embodiment within 1% and in another embodiment within 0.5%. The term "coupled" as used herein is defined as connected, although not necessarily directly and not necessarily mechanically. A device or structure that is "configured" in a certain way is configured in at least that way, but may also be configured in ways that are not listed.

It will be appreciated that some embodiments may include of one or more generic or specialized processors (or "processing devices") such as microprocessors, digital signal processors, customized processors and field programmable gate arrays (FPGAs) and unique stored program instructions (including both software and firmware) that control the one or more processors to implement, in conjunction with certain non-processor circuits, some, most, or all of the functions of the method and/or apparatus described herein. Alternatively, some or all functions could be implemented by a state machine that has no stored program instructions, or in one or more application specific integrated circuits (ASICs), in which each function or some combinations of certain of the functions are implemented as custom logic. Of course, a combination of the two approaches could be used.

Moreover, an embodiment can be implemented as a computer-readable storage medium having computer readable code stored thereon for programming a computer (e.g., including a processor) to perform a method as described and claimed herein. Examples of such computer-readable storage mediums include, but are not limited to, a hard disk, a CD-ROM, an optical storage device, a magnetic storage device, a ROM (Read Only Memory), a PROM (Programmable Read Only Memory), an EPROM (Erasable Programmable Read Only Memory), an EEPROM (Electrically Erasable Programmable Read Only Memory) and a Flash memory. Further, it is expected that one of ordinary skill, notwithstanding possibly significant effort and many design choices motivated by, for example, available time, current technology, and economic considerations, when guided by the concepts and principles disclosed herein will be readily capable of generating such software instructions and programs and ICs with minimal experimentation.

The Abstract of the Disclosure is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the

following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

We claim:

1. A method performed by a primary processor of an electronic device for extending an authentication timeout period for the electronic device, the method comprising:

initiating an authentication timeout period at a timeout initiation time;

putting the primary processor into a sleep mode;

awakening the primary processor from the sleep mode at an expiration time, upon expiration of the authentication timeout period, and determining whether an authentication timeout extending input was detected by an adjunct processor of the electronic device at an input detection time that occurred during the authentication timeout period; and

extending the authentication timeout period to expire at an extended expiration time, which is based on the input detection time, when the authentication timeout extending input was detected by the adjunct processor or locking the electronic device when the authentication timeout extending input was not detected by the adjunct processor.

2. The method of claim **1**, wherein the extended expiration time is further based on a number of authentication timeout extending inputs detected during the authentication timeout period.

3. The method of claim **1**, wherein the extended expiration time is further based on a type of authentication timeout extending input received.

4. The method of claim **1**, wherein the extended expiration time is the expiration time plus the input detection time less the timeout initiation time.

5. The method of claim **1** further comprising returning the primary processor to the sleep mode after extending the authentication timeout period.

6. The method of claim **5** further comprising;

awakening the primary processor from the sleep mode at the extended expiration time and determining whether a subsequent authentication timeout extending input was detected by the adjunct processor at a subsequent input detection time that occurred after the expiration time; and

extending the extended authentication timeout period by a time interval comprising the subsequent input detection time less the first input detection time and returning the primary processor to the sleep mode when the subsequent authentication timeout extending input was detected by the adjunct processor or locking the electronic device and returning the primary processor to the sleep mode when the subsequent authentication timeout extending input was not detected by the adjunct processor.

7. The method of claim **1**, wherein the authentication timeout extending input is generated as a result of an event comprising at least one of:

a contact to a touchscreen of the electronic device;

a contact to a housing of the electronic device;

a shaking of the electronic device;

an object being in proximity to the electronic device;

a gesture directed to the electronic device; or

speech input into the electronic device.

8. The method of claim **7**, wherein the authentication timeout extending input is detected by the adjunct processor when a duration of the event exceeds a threshold time interval.

9. The method of claim **1**, wherein when the authentication timeout extending input was detected, the method further comprising:

extending the authentication timeout period to expire at the extended expiration time when the input detection time is outside of a threshold time interval of the timeout initiation time; or

locking the electronic device when the input detection time is within the threshold time interval of the timeout initiation time.

10. The method of claim **1**, wherein locking the electronic device is postponed while the electronic device is in the presence of a wireless access point.

11. The method of claim **10**, wherein locking the electronic device is postponed when the wireless access point is a trusted wireless access point.

12. The method of claim **1**, wherein the authentication timeout extending input is generated as a result of a contact to a touchscreen of the electronic device after a notification is displayed on the touchscreen.

13. An electronic device configured to extend an authentication timeout period for the electronic device, the electronic device comprising:

an adjunct processor configured to detect, while a primary processor is in a sleep mode, an authentication timeout extending input occurring at an input detection time during an authentication timeout period initiated at a timeout initiation time; and

the primary processor coupled to the adjunct processor and configured to:

awaken from the sleep mode upon expiration of the authentication timeout period at an expiration time, and determine that the authentication timeout extending input was detected by the adjunct processor during the authentication timeout period; and

extend the authentication timeout period to expire at an extended expiration time, which is based on the input detection time.

14. The electronic device of claim **13**, wherein the extended expiration time is the expiration time plus input detection time less the timeout initiation time.

15. The electronic device of claim **13** further comprising a touchscreen coupled to the adjunct processor, wherein the touchscreen is configured to detect tactile input and responsively provide the authentication timeout extending input to the adjunct processor.

16. The electronic device of claim **13** further comprising at least one touch sensor coupled to the adjunct processor, wherein the at least one touch sensor is configured to detect tactile input and responsively provide the authentication timeout extending input to the adjunct processor.

17. The electronic device of claim **13** further comprising at least one proximity sensor coupled to the adjunct processor, wherein the at least one proximity sensor is configured to detect proximity of an object to the electronic device and responsively provide the authentication timeout extending input to the adjunct processor.

18. The electronic device of claim **13** further comprising at least one acoustic transducer coupled to the adjunct processor, wherein the at least one acoustic transducer is configured to detect audio input and responsively provide the authentication timeout extending input to the adjunct processor.

19. The electronic device of claim **13** further comprising at least one motion sensor coupled to the adjunct processor, wherein the at least one motion sensor is configured to detect a motion of the device and responsively provide the authentication timeout extending input to the adjunct processor.

20. The electronic device of claim **13**, wherein the electronic device further comprises a memory component coupled to the adjunct processor and the primary processor, wherein the memory component is configured to store a timestamp that indicates the input detection time.

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